User Manual

SVF-L SERIES

VARIABLE SPEED AC MOTOR DRIVE

230V 25W – 100W

HIGH PERFORMANCE / EASY CONTROL AC DRIVE

SVF40WL21A SVF001L21A

Read this manual carefully before using the drive, also, keep this manual handy in case of emergency

5011609101
20020301
LEF1

SPG Co., Ltd.
67B/L 12LOT 628-11 GOJAN-DONG
NAMDONG-GU INCHON, KOREA
http://www.spg.co.kr
TEL : 82-32-812-7090
FAX : 82-32-812-6218

1

Preface

Thank you for choosing SPG's high-performance SVF-L Series. SVF-L Series are manufactured by adopting the high-quality components, materials and incorporating the latest microprocessor technology available.

This manual will be helpful in installation, parameter setting, troubleshooting, and daily maintenance of the AC motor drives. To guarantee safe operation of the equipment, read the following safety guidelines before installing the AC motor drives. Keep this operating manual handy and distribute to users for reference.

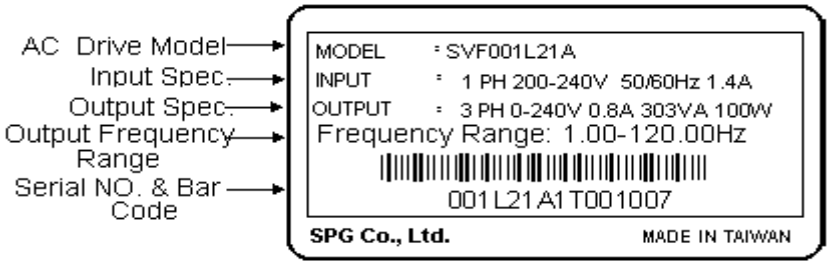
Receiving and Inspection

This SVF-L AC drive has gone through rigorous quality control tests at the factory before shipment. After receiving the AC motor drive, please check the following:

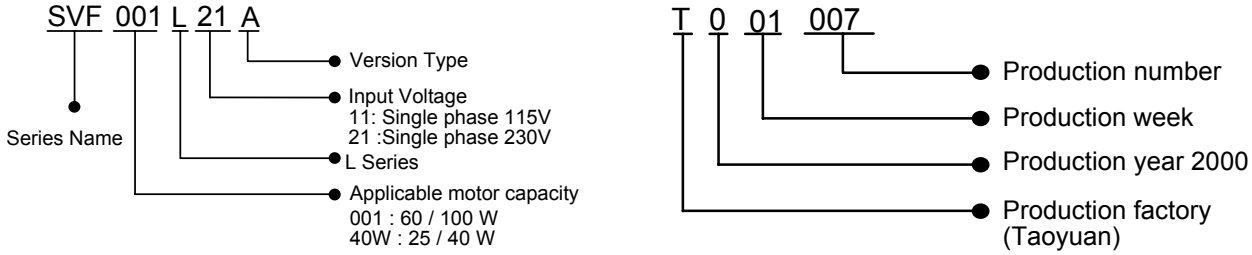
Receiving

- ✓ Make sure that the package includes an AC motor drive and the User Manual.
- ✓ Inspect whether the unit is damaged during the shipment.
- ✓ Make sure that the part number indicated on the nameplate corresponds with the part number of your order.

Nameplate Information: Example of the 100W 230V AC drive



Model Explanation and Series Number Explanation:



Contact your supplier if there is any problem or that any of the nameplate information does not correspond to your purchase order.

⚠ **DANGER! Power must be disconnected before any maintenance. Do not connect or disconnect any wires and connectors while the power is still ON.**

⚠ **CAUTION! The MOS components within the AC motor drive are especially sensitive to static, therefore, do not touch these components or the circuit boards with metal objects or bare hands.**

⚠ **CAUTION! Ground the SVF-L with the ground terminal. The grounding method must comply with the laws of the country where the AC motor drive is to be installed.**

CAUTION! Temperature of the heat sink might go over 70°C (158°F) during the operation, and users should be advised not to touch it.

2

Storage and Installations

Storage:

The AC motor drive should be kept in the shipping carton before installation. In order to retain the warranty coverage, the AC motor drive should be stored properly for an extended period of time when not in use.

Ambient Conditions:

Operation	Temperature:	-10° C to +40° C (14° F to 122° F)
	Atmosphere Pressure:	86 to 106 kPa
	Installation Site Altitude:	Under 1000m
	Vibration:	Maximum 9.86 m/s^2 (1G) for less than 20Hz Maximum 5.88 m/s^2 (1G) for 20Hz to 50Hz
Storage	Temperature:	-20° C to + 60° C (-4° F to 140° F)
	Relative Humidity:	Less than 90%, condensation not allowed
	Atmosphere Pressure:	86 to 106 kPa
Transportation	Temperature:	-20° C to +60° C (-4° F to 140° F)
	Relative Humidity:	Less than 90%, condensation not allowed
	Atmosphere Pressure:	86 to 106 kPa
	Vibration:	Maximum 9.86 m/s^2 (1G) for less than 20Hz Maximum 5.88 m/s^2 (1G) for 20Hz to 50Hz

Installations and Connection:

⚠ CAUTION

The control, power supply and motor leads must be laid separately; they must not be fed through the same cable conduit / trucking.

High voltage insulation test equipment must not be used on cables connected to the drive.

Wait for at least 1 minute for the DC bus capacitors to discharge.

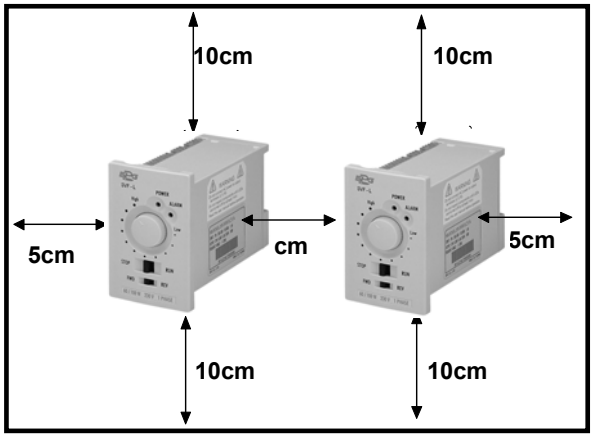
Any Electrical or mechanical modification to this equipment without prior written consent of SPG Co., Ltd. will void all warranties and may result in a safety hazard in addition to voiding the UL listing.

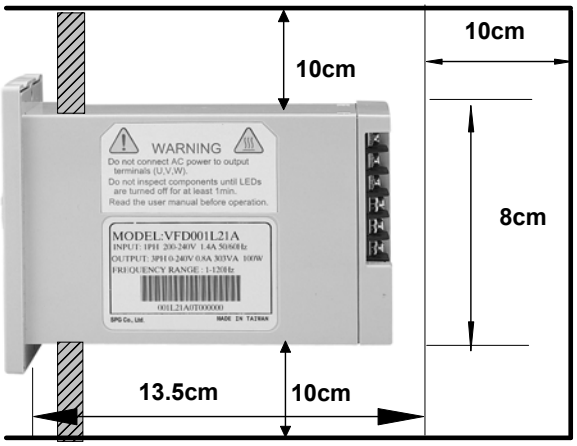
Short Circuit Withstand:

Suitable for use with circuits that are capable of delivering no more than 5,000 rms symmetrical amperes; for the 230V Models, the maximum is 240 Volts.

Improper installation of the AC motor drive will greatly reduce its usage. Be sure to observe the following precautions when selecting a mounting location. **Failure to abide by these precautions may void the warranty!**

- **Do not mount the AC motor drive near heat-radiating elements or under direct sunlight.**
- **Do not install the AC motor drive in places subject to high temperature, high humidity, excessive vibration, corrosive gases or liquids, airborne dust or metallic particles.**
- **Mount the AC motor drive vertically and keep the heat sink ventilated.**
- **The AC motor drive generates heat during operation; allow sufficient space around the unit for heat dissipation as shown in the following figure:**

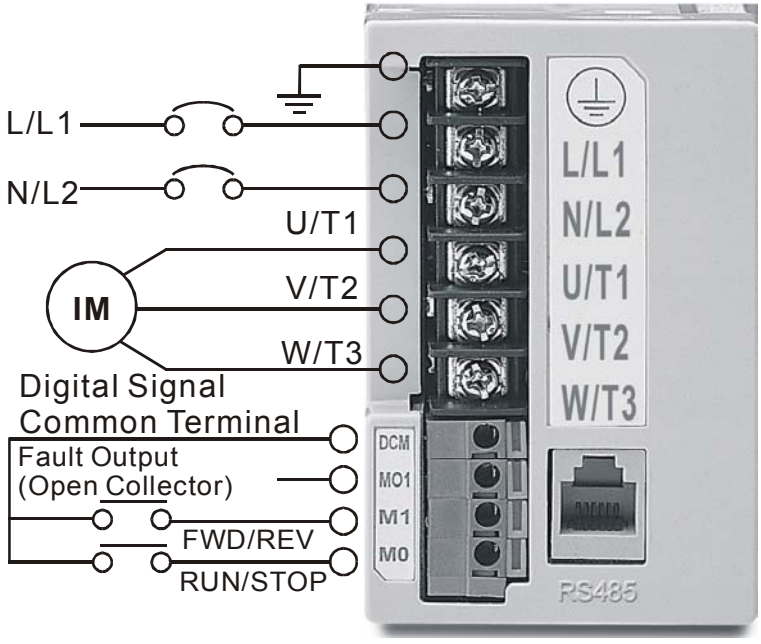




Connections:

Installations intended to meet the UL and CUL requirements must follow the instructions provided in the “Wiring Notes” section below as a minimum standard. Where local codes exceed these requirements, they must be followed as well; refer to the technical data label affixed to the AC motor drive and the motor nameplate for electrical data.

Basic Wiring Diagram
Users must connect the wiring according to the following circuit diagram.



Wire Gauge: 22-14 AWG
Torque: 10kgf-cm
(8.7 in-lbf)

RS-485 Serial Interface
1 : +EV
2 : GND
3 : SG−
4 : SG+
PIN 1 & 2 are the power source for the digital keypad and should not be used while using RS-485 communication.

***NOTE*:** Do not plug a Modem or telephone line to the RS-485 communication port, permanent damage may result. Terminals 1 & 2 are the power sources for the digital keypad and should not be used while using the RS-485 communication.

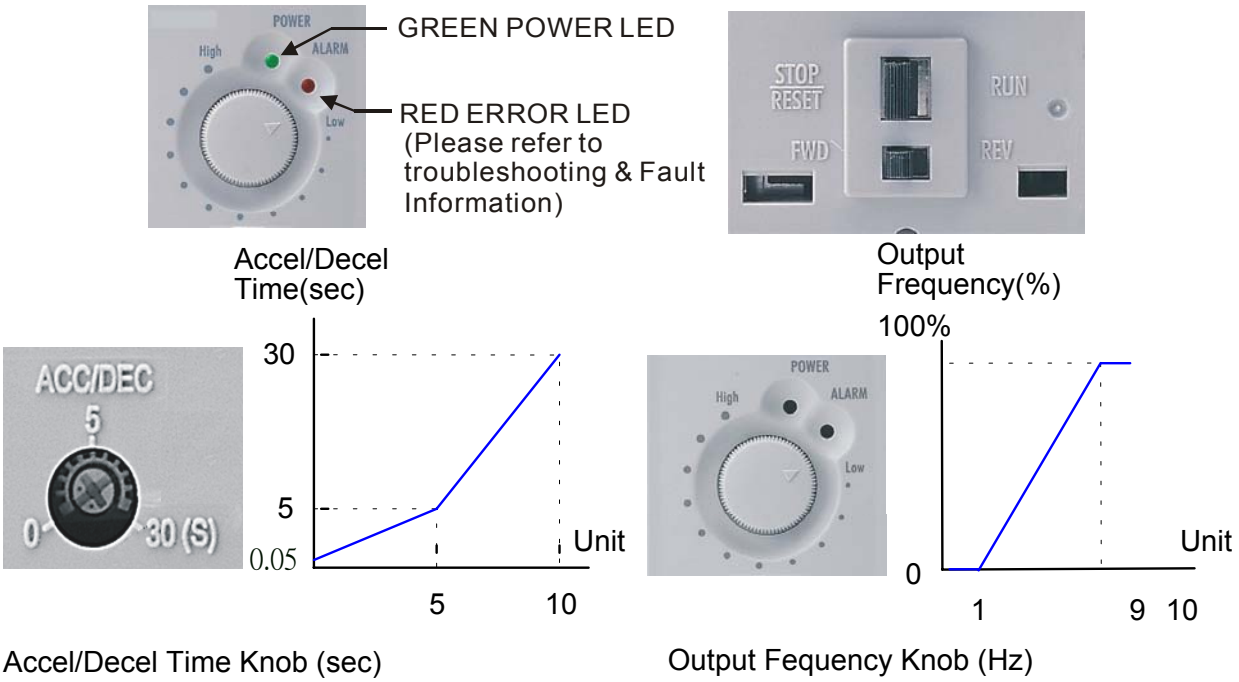
Main Circuit Terminals: wire gauge 22-14AWG, torque 10kgf-cm (8.7 in-lbf)

Terminal Symbols	Terminal Functions
L/L1, N/L2	Main circuit - AC power input
U/T1, V/T2, W/T3	Connect to the Motor
⏚	Earth Ground

Control Circuit Wiring: wire gauge 22-14AWG, torque 10kgf-cm (8.7 in-lbf)

Terminal Symbols	Terminal Names	Remarks
M0	RUN/STOP	After M0 closes up to DCM, the AC motor will start operating.
M1	FWD/REV	After M1 closes up to DCM, the AC motor will operate in REV direction.
MO1	Fault Indication	When an error is detected, MO1 will close up to DCM.
RS-485	Serial Communication Interface	**When DIP Switch 7 is ON, the drive can be controlled by RS-485.**
DCM	Common Terminals of the Digital Signal	Ground for M0, M1 and M01

- **Front Panel Control Diagram**



Accel/Decel Time Knob (sec)

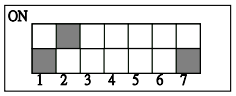
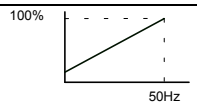
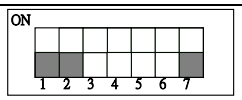
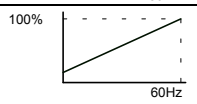
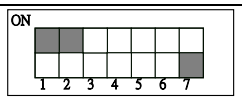
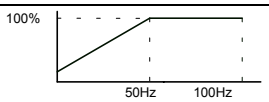
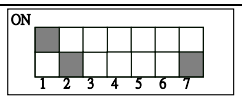
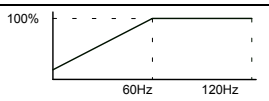
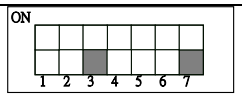
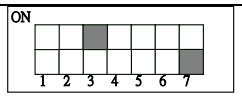
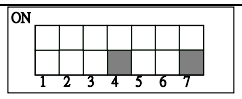
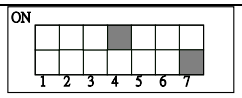
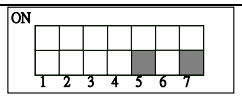
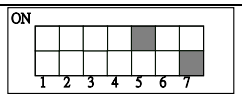
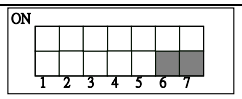
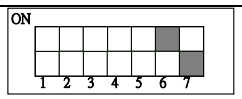
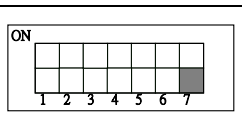
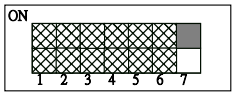
Output Fequency Knob (Hz)

5

Switch Setting Descriptions:

The DIP Switches can only be changed when AC drive is in the stop mode.

■ Indicates the position of the switch (ON/OFF).

DIP Switch	Switch Name	Switch Setting	Parameter Descriptions	
1	Max. Output Frequency		Maximum Output Frequency	V/F Curve
			50Hz	
			60Hz	
2			100Hz	
			120Hz	
3	Reverse Inhibit		Reverse enable	
			Reverse disable	
4	Torque Setting		Low torque output	
			High torque output	
5	Electronic Thermal Setting		Applicable for 40/100W motor	
			Applicable for 25/60W motor	
6	Operation Command Source Select (1)		Operation command controlled by the front panel	
			Operation command controlled by the external terminal	
7	Operation Command Source Select (2)		Operation command controlled by the front panel or the external terminal (can be monitored by communication mode)	
			Switch 7 is ON, indicates the communication mode is enabled; switches 1 to 6 are address settings.	

6
Communication

There are three control modes within SVF-L: the communication, the front panel and the external terminal modes. Only one mode can be used at a time, and the mode in use is selected by DIP Switch 6 and 7. Based on the status of the DIP Switch, the SVF-L then decides which mode would take control (the DIP Switch could only be switched when the drive is in the stop mode). When in the communication control mode, commands from either the front panel or the external terminal will all be invalid, and the AC motor drive could only be operated based on the parameter contents saved earlier in the memory. When DIP Switch 7 is adjusted to OFF (the communication monitoring mode), the parameter values and addresses set previously under the communication mode can all be saved in the memory (caution: commands will not be saved if power is not supplied). And when the SVF-L is switched to the front panel or the external terminal control mode, the communication mode could still be used to read the status of the AC motor drive, but its commands will not be taken.

- When DIP Switch 7 is adjusted from “ON” to “OFF” (controlled by the front panel or the external terminal), and that the RUN/STOP switch of the front panel or the external terminal is at the operation end, the AC motor drive will execute the operation immediately.
- When DIP Switch 7 is adjusted from “OFF” to “ON” (controlled by the communication mode), and before it is switched to “ON”, the AC motor drive should be at the stop mode, otherwise, the error LED will be on and that the AC motor drive will not be operated immediately after the switching (caution: whether it is of FWD or REV previously, after it is switched to the communication mode, it is FWD straight through).

Computer Controls

Each SVF-L AC Drive has a pre-assigned communication address specified by DIP Switch pins 1 to 6 (Refer to the description of setting up address). SVF-L type Communication agreement: Modbus ASCII mode, protocol <7, N, 2>, Baud rate 9600. The computer then controls each AC Drive according to its communication address.

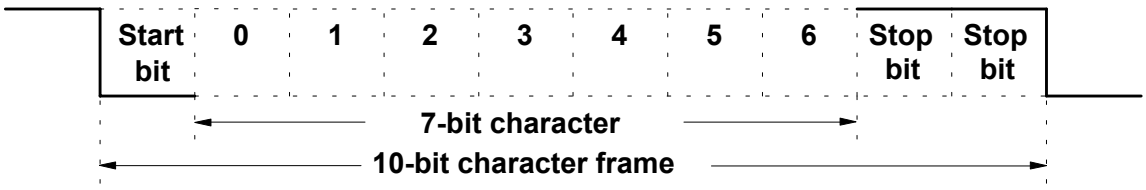
- ASCII Modes:

Each 8-bit data is the combination of two ASCII characters. For example, a 1-byte data: 64 Hex, shown as ‘64’ in ASCII, consists of ‘6’ (36Hex) and ‘4’ (34Hex).

Character	‘0’	‘1’	‘2’	‘3’	‘4’	‘5’	‘6’	‘7’
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H
Character	‘8’	‘9’	‘A’	‘B’	‘C’	‘D’	‘E’	‘F’
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

- Data Format

10-bit character frame (For 7-bit character): ❖ (7, N, 2)



AC Drive Setting Addresses for RS-485 Communication

(1) The SVF-L series would read the communication address only at the instant when the power is ON. If DIP Switch 7 is “ON” (the communication control), the ON/OFF status of DIP_SW1~6 will thus be regarded as the address setting; if DIP Switch 7 is set to be controlled by the front panel or the external terminal (the DIP Switch 7 is “OFF”) when power is on, the communication address will then be the

contents of parameter 0008H saved previously in the memory. Use the default setting, 01, if the address is to be used for the first time, otherwise, use the previous setting.

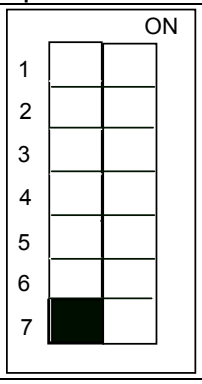
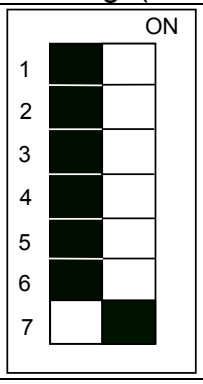
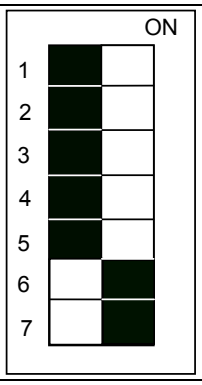
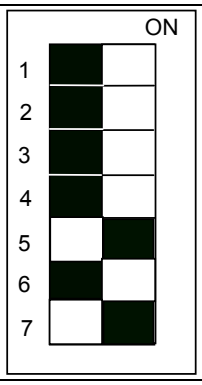
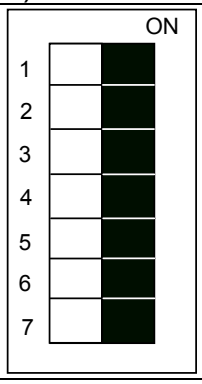
(A) The address will not be changed if the control mode is switched back to the front panel or the external terminal control.

(B) The address will not be changed when the parameter is being reset.

(2) DIP Switch 1 is the upper most bit while DIP Switch 6 is the lower most bit, thus, it is “1” when Switch “ON”, and “0” when Switch “OFF”. Since the MODBUS has regulated Address 0 as broadcasting-specific, the possible communication addresses could go from 1~63. (Regarded as Address 1 if it is “OFF” all the way through).

(3) Be sure to turn the power off and to reset the address through the DIP Switch if the communication address is to be changed (DIP Switch 7 is set as “ON”); the new address could be read as soon as the power is turned back on.

◆ Example of the Address Setting: (the black block is to indicate the DIP ON or OFF)

				
Communication Inhibits	Communication address is 01	Communication Address is 01	Communication Address is 02	Communication Address is 63

Communication Protocol

Communication Data Frame:

STX	Start character ‘:’ (3AH)
ADR 1 ADR 0	Communication address: 8-bit address consists of 2 ASCII codes
CMD 1 CMD 0	Command code: 8-bit command consists of 2 ASCII codes
DATA (n-1) To DATA 0	Contents of data: n x 8-bit data consist of 2n ASCII codes. n ≤ 25, maximum of 50 ASCII codes
LRC CHK 1 LRC CHK 0	LRC check sum: 8-bit check sum consists of 2 ASCII codes
END 1 END 0	End characters: END1 = CR (0DH), END0 = LF (0AH)

◆ ADR (Communication Address)
Valid communication addresses are in the range of 1 to 63. Communication address equal to 0, means broadcast to all AC drives. In this case, the AMD will not reply any message to the master device.

◆ CMD (Command code) and DATA (data characters)
The format of data characters depends on the command code. The available command codes are described as followed:

Command code: 03H, read N words. The maximum value of N is 12. For example, reading continuous 2 words from starting address 2102H of AMD with address 01H				Command code: 06H, write 1 word For example, writing 6000 (1770H) to address 2001H of AMD with address 01H.			
Command message:		Response message:		Command message:		Response message:	
STX	':'	STX	':'	STX	':'	STX	':'
ADR 1	'0'	ADR 1	'0'	ADR 1	'0'	ADR 1	'0'
ADR 0	'1'	ADR 0	'1'	ADR 0	'1'	ADR 0	'1'
CMD 1	'0'	CMD 1	'0'	CMD 1	'0'	CMD 1	'0'
CMD 0	'3'	CMD 0	'3'	CMD 0	'6'	CMD 0	'6'
Starting data address	'2'	Number of data (byte)	'0'	Data address	'2'	Data address	'2'
	'1'				'0'		'0'
	'0'		'4'		'0'		'0'
	'2'				'1'		'1'
Number of data (Count by word)	'0'	Content of starting data address 2102H	'1'	Data content	'1'	Data content	'1'
			'7'				
	'0'		'7'		'7'		'7'
			'0'				
	'0'	Content of data address 2103H	'0'		'7'		'7'
			'0'				
	'2'		'0'		'0'		'0'
			'0'				
LRC CHK 1	'D'	LRC CHK 1	'7'	LRC CHK 1	"5'	LRC CHK 1	'5'
LRC CHK 0	'7'	LRC CHK 0	'1'	LRC CHK 0	'1'	LRC CHK 0	'1'
END 1	CR	END 1	CR	END 1	CR	END 1	CR
END 0	LF	END 0	LF	END 0	LF	END 0	LF

- CHK (check sum)
  LRC (Longitudinal Redundancy Check) is calculated by summing up the values of the bytes from ADR1 to last data character then calculating the hexadecimal representation of the 2's-complement negation of the sum. For example, using the command message of above:

STX	':'	01H+03H+21H+02H+00H+02H=29H, the 2's-complement negation of 29H is D7H.
ADR 1	'0'	
ADR 2	'1'	
CMD 1	'0'	
CMD 2	'3'	
STARTING DATA ADDRESS	'2'	
	'1'	
	'0'	
	'2'	
NUMBER OF DATA	'0'	
	'0'	
	'0'	
	'2'	
LRC CHK 1	'D'	
LRC CHK 0	'7'	
END 1	CR	
END 0	LF	

9

Parameters (saved in the EEPROM) ★: the parameter can be set during the operation.

Parameter	Parameter Function	Parameter Setting	Factory Setting	Customer Setting
0	Identity code of Drive	Depend on drive	#	Read only
1	Rating current	Depend on drive	#.#	Read only
2	Parameter Reset	10: Reset	0	Read/Write
3	Max. Operation Freq.	0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 120 Hz	1	Read/Write
★4	Accel/Decel Time	0.05 to 30.00 sec	5.00	Read/Write
5	Reverse Inhibit	0: Reverse disable 1: Reverse enable	1	Read/Write
6	Torque Increase	0: High Torque 1: Low Torque	1	Read/Write
7	Electronic Thermal	0: 25/60 W 1: 40/100 W	1	Read/Write
8	Communication Addresses	01 to 63	1	**Read Only**
9	Software Version	Read only	#.#	Read Only

Address List:
The contents of available addresses are shown as below:

Content:	Address:	Function:	
AC drive Parameters	nnnnH	nnnn means parameter number, for example, the address of 0004 is 0004H. When reading parameter by command code 03H, only one parameter can be read at one time.	
Command Write only	2000H	Bit 0 to 1	00B: No function 01B: Stop 10B: Run 11B: No function
		Bit 2 to 3	Reserved
		Bit 4 to 5	00B: No function 01B: FWD 10B: REV 11B: Change direction
		Bit 6 to 15	Reserved
	2001H	Frequency command	
	2002H	Bit 0	1: Reserved
		Bit 1	1: Reset
		Bit 2-15	Reserved

Content:	Address:	Function:	
Status monitor (Read only)	2100H	Error Codes 00: No error occurred 01: Over-current (oc) 02: Over-voltage (ov) 03: Overheat (oH) 04: Overload (oL) 05, 06: Reserved 07: CPU failure (cF3) 08 to 13: Reserved 14: Low voltage (Lv) 15: CPU failure 1 (cF1) 16: CPU failure 2 (cF2) 17 to 19: Reserved 20: Software protection 21: Operation error 22: OH Hardware failure cF3.1 23: OV Hardware failure cF3.2 24: LV Hardware failure cF3.3 26: Hardware failure cF3.5 (current detection) 30: Hardware failure hpf.2 31: Hardware failure hpf.3	
	2101H	Bit 0 to 1	00: STOP 01: Ramp stop 10: Zero speed 11: Operation
		Bit 2	Reserved
		Bit 3 to 4	00: Forward motion 01: from Reverse to Forward motion 10: from Forward to Reverse motion 11: Reverse motion
		Bit 5 to 9	Reserved
		Bit 10	1: Operation commands are controlled by communication interface.
		Bit 11 to 15	Reserved
	2102H	Frequency Command F (XXX.XX)	
	2103H	Output Frequency H (XXX.XX)	
	2104H	Output Current A (X.XX)	
	2105H	DC-BUS Voltage (XXX)	
	2106H	Output Voltage E (XXX.X)	

Exception Responses:

Except for broadcast messages, the AC drive is been expected to return a normal response after receiving command messages from the master device. The following depicts the conditions that no normal response is replied to the master device.

The AC drive does not receive the messages due to a communication error; thus, the AC drive has no response. The master device will eventually process a timeout condition.
The AC drive receives the messages without a communication error, but cannot handle it, an exception response will return to the master device. In the exception response, the most significant bit of the original command code is set to 1, and an exception code explains the condition that caused the exception is returned. An example of exception response of command code 06H and exception code 02H:

STX	':'	3AH
ADDRESS 1	'0'	30H
ADDRESS 0	'1'	31H
FUNCTION (CMD) 1	'8'	38H
FUNCTION (CMD) 2	'6'	36H
EXCEPTION	'0'	30H
CODE	'2'	32H
LRC CHK 1	'C'	43H
LRC CHK 0	'F'	46H
END 1	CR	0DH
END 0	LF	0AH

The explanation of exception codes:

Exception codes:	Explanation
01	Illegal command code: The command code received in the command message is not available for the AC drive.
02	Illegal data address: The data address received in the command message is not available for the AC drive.
03	Illegal data value: The data value received in the command message is over range for the AC drive.
04	Slave device failure: The AC drive is unable to perform the requested action.
09	Check Sum Error: Check if the Check Sum is correct.
20	Watchdog Timer: The timer will reset to 0 after each valid MODBUS communication message is received.

12
Maintenance and Inspections

Modern AC drives are based on solid state electronics technology, preventive maintenance is required to operate this AC drive in its optimal condition, and to ensure a long life. It is recommended to perform a monthly check up of the AC drive by a qualified technician. Before the check up, always turn off the AC Input Power to the unit. Wait at least 2 minutes after all display lamps have gone out, and then confirm that the capacitors have fully discharged.

Periodic Inspection:

Basic check up items to detect if there were any abnormality during the operation.

1. Whether the motors are operating as expected.
2. Whether the installation environment is abnormal.
3. Whether the cooling system is operating as expected.
4. Whether any irregular vibration or sound occurred during the operation.
5. Whether the motors are overheated during the operation.
6. Always check the input voltage of the AC drive with Voltmeter.

Periodic Maintenance:

It is necessary to stop the motor operation during the check up.

1. Tighten and reinforce the screws of the AC drive if necessary, cause it may loose due to the vibration or changing of temperatures.
2. Whether the conductors or insulators were corroded and damaged.
3. Check the resistance of the insulation with Megaohmeter.
4. Often check and change the capacitors and relays.
5. If use of the AC drive is discontinued for a long period of time, turn the power on at least once every two years and confirm that it still functions properly. To confirm functionality, disconnect the motor and energize the AC drive for 5 hours or more before attempting to run a motor with it.
6. Clean off any dust and dirt with a vacuum cleaner. Place special emphasis on cleaning the ventilation ports and PCBs. Always keep these areas clean, as adherence of dust and dirt can cause unforeseen failures.

Fuse and No Fuse Breaker (NFB) Specifications:

Model	Ampere Rating (A)	Manufacturer (Reference)
40W 230V	3.0A	Bussmann - JJN-3 300V
100W 230V	6.0A	Bussmann - JJN-6 300V

13

Troubleshooting and Fault Information

The AC drive has a comprehensive fault diagnostic system that includes several different alarms and fault message. Once a fault is detected, the corresponding protective functions will be activated to shut down the AC drive output. Below are the fault descriptions, for a fault shown on the AC drive digital keypad. After fault has been cleared, switch the Run/Stop key to stop mode to reset the drive.

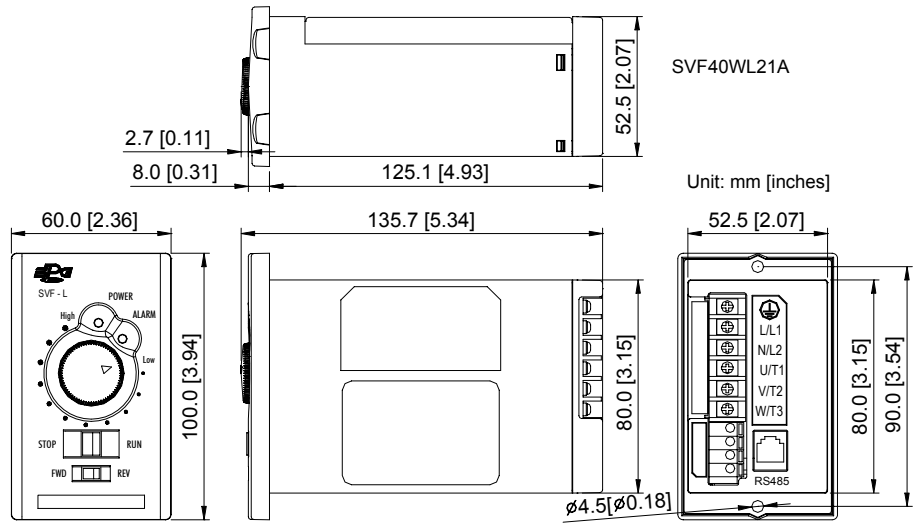
Fault Display	Fault Descriptions	Corrective Actions
Alarm LED lighten after power on	Hardware failure	Return to the factory
Alarm LED flashes once in every two seconds (Over-current)	The AC drive detects an abnormal increase in current	1. Increase the acceleration time 2. Check whether the motor output power corresponds to the AC drive output power 3. Check the wiring connection between the AC drive and motor for possible short circuit 4. Check for possible over loading conditions at the motor
Alarm LED flashes twice in every two seconds (Over-voltage)	The AC drive detects that the DC-BUS voltage has exceeded its maximum allowable value	1. Check whether the input voltage falls within the rated AC Drive input voltage. 2. Check for possible voltage transients. 3. Bus over-voltage may be caused by motor regeneration, increase the accel/decel time.
Alarm LED flash thrice in every two seconds (Overload)	Motor overload	1. Check for possible motor overload. 2. Adjust torque detection setting of the DIP SW4 to an appropriate setting. 3. Increase the AC Drive's output capacity.
Alarm LED flashes four times in every two seconds (Over-heating)	The AC drive temperature sensor detects excessive heat.	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure that the ventilation holes are not obstructed. 3. Provide enough spacing for adequate ventilation.
Alarm LED flashes five times in every two seconds (Low voltage)	The AC drive detects that the DC Bus Voltage has fallen below its minimum value.	Check whether the input voltage falls within the rated AC Drive input voltage.
Alarm LED flashes every second	Change DIP SW while drive is running	Switch the Run/Stop key to Stop mode to reset the AC drive.

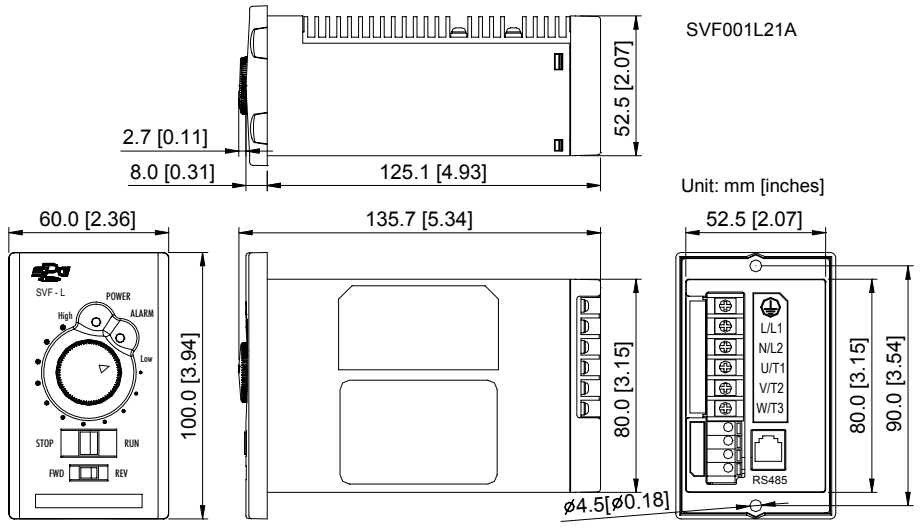
14

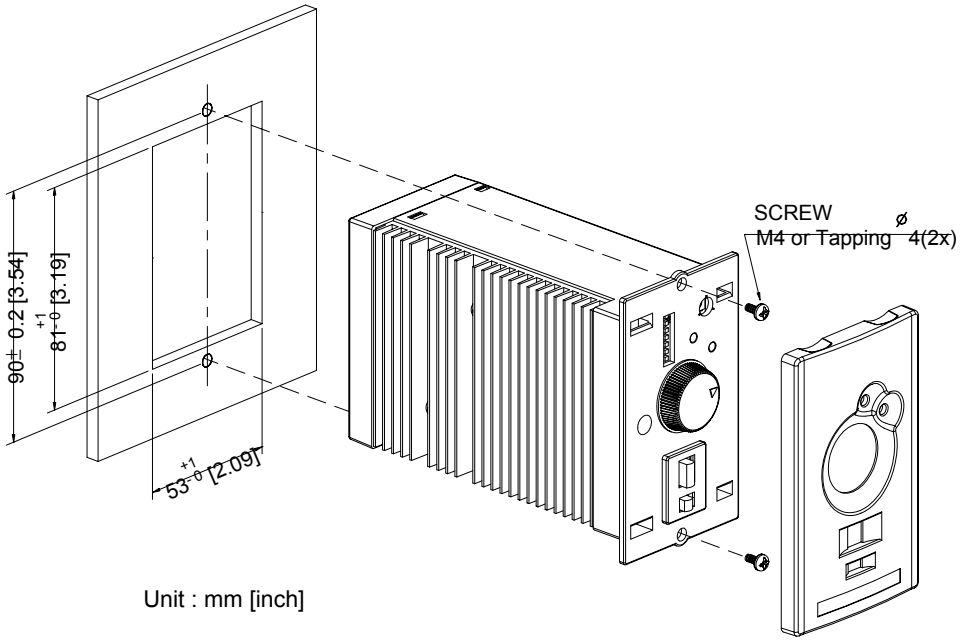
Standard Specifications

Voltage Class			230V Class			
Model Number SVF- □□□L 21 A			40W		001	
Weight g (lb) A (standard)			260 (0.57)		430 (0.95)	
Max. Applicable Motor Output (W)			25/40		60/100	
Output Rating	Rated Output Capacity (VA)		106/152		212/303	
	Rated Output Current (A)		0.28/0.4		0.56/0.8	
	Maximum Output Voltage (V)		Proportional to Input Voltage			
	Rated Frequency (Hz)		1.00 to 120.00 Hz			
Input Rating	Rated Voltage/Frequency		Single phase200 to 240 VAC 50/60Hz			
	Voltage/Freq. Tolerance		Voltage: ±10%, Frequency: ±5%			
	Input Current (A)		0.5A	0.7A	1.0A	1.4A
Control Characteristics	Control Systems		SVPWM (Space Vector Pulse Width Modulation, carrier frequency 10kHz)			
	Torque Setting		High/Low, Switching			
	Overload Endurance		150% of rated current for 1 minute			
	Accel/Decel Time		0.05 to 30.0 seconds			
	Torque Promotion		Torque Boots: 0 or 3%			
Control Characteristics	Frequency Setting		Potentiometer, RS-485			
	Operation Setting Signal	Panel	RUN/STOP, FORWARD/REVERSE			
		Ext. Terminal	RUN/STOP, FORWARD/REVERSE, RS-485			
	Output Indication	Panel	Fault Indication (LED Flash)			
		Ext. Terminal	Fault Indication (Open Collector)			
Protection			Self-testing, Over Voltage, Over Current, Under Voltage, Overload, Overheating, Thermal.			
Cooling			Natural air-cooling			
Environment	Installation Location		Altitude 1,000m or lower, keep from corrosive gasses, liquid and dust			
	Pollution Degree		2			
	Ambient Temperature		-10°C to 40°C (Non-Condensing and not frozen)			
	Storage Temperature		-20°C to 60°C			
	Ambient Humidity		Below 90% RH (non-condensing)			
	Vibration		9.80665m/s^2 (1G) less than 20Hz, 5.88m/s^2 (0.6G) at 20 to 50Hz			

15
Dimensions







Unit : mm [inch]